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Environmental Factor Shaping Blow Fly Development in Forensic Perspective

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Abstract:

Environmental factors mainly temperature, humidity, soil pH are help in shaping blowfly development. Blow flies are species specific and have a powerful impact on the geographical area. Research work can be conducted in the Mullanpur, Punjab and mainly the blow fly species which is the key component of our research work is Chrysomya megacephala. In this research work the instrument used for measuring these factors like environmental temperature, soil pH, humidity, carcass body temperature, ambient temperature, rate of decomposition by thermometer, hygrometer, pH meter. The increase in temperature result in increase in rate of decomposition and decrease in temperature result in slowdown in the process of decomposition. For our research work the time we choose was from march to April.

Keywords: Environmental factor, decomposition, Chrysomyamegacephala.

Introduction

Blow flies are the first insect which can be observe and colonize on human and animal remains. Blowflies are come under the family of calliphoridae. Flies which can we studied in our work is Chrysomyamegacephala. This family of insect contain metallic blue and green flies which should commonly occur on re fuse and waste during the summer season. The rate of development of blowfly is dependent on the temperature. Which can make blow flies to use in the investigation as the death evidence which further used to calculate the post mortem interval (Monzon et al.). Blowflies and their time of development in specific species is required to correctly known about the blowfly species and the temperature to accurately estimate the post mortem interval (Zhang et al.). The relationship between the development of insect and the temperature among the behaviour aspects is crucial to calculate the correct post mortem interval. This study is used to determine the time of development of C. variform at the seven constant temperature which are ranged from 12 to 30°C (Voss et al.). The rate of growth of maggots is mainly taken by temperature generally the entomologist must estimate the relevant temperature and also correlate with the weather station data with temperature loggers placed in the crime scene (Johnson et al.). The analysis is correct to verify the environmental factors occurrence of species. The important of this group is to give the knowledge about the mean temperature and

humidity on the occurrence of blowfly species (Azevedo et al.). Many studies such as Slone et al. have taken the mass temperature based on the mass the density and species instar composition. The weight of the larvae is found that increase in temperature can explain the difference in weight with in the second and third instar masses and if the weight should be same for first and second instar masses then the temperature generated should be equivalent while such type of studies can help to know about the factors contribute the temperature generate with in the maggot (Johnson et al.). The development of blowflies can be used to calculate the post mortem rate (Ames and Turner2003). Environmental factor such as temperature, relative humidity, light intensity, wind speed can also affect the colonization time and flight activity of blow fly. In environmental factors mainly temperature has been recorded for the blow fly activity and in several studies the flight activity of blowfly has been postulated under the positive influence of temperature (Lutz et al.). The necrophagous flies can occur with the temperature range of 10°c and 30°c and exception of 30°c to 32°c. Temperature of body not be regulated by the insect it is the temperature of environment which regulate their development process. Temperature had an influence potential for the interaction of species. Development of insect can occur in the range of maximum limits and minimum limits which can tell the highest and lowest temperature at which the development of insects takes place (Okpara et al.). Many of insect species and their developmental rates are different under different temperature as compared to the constant temperature (Clarkson et al.).

Importance of blowfly development

The blowfly development is important for calculating the accurate PMI rate. The correct PMI estimation can talk about the death of last living person. Through the growth of blowflies, the rate of decomposition can also be calculated. Mainly the growth of blow fly depends on the environmental factors such as temperature, humidity, pH. For the development of insect mainly the temperature is the most common parameters and also for the development of blowflies. Temperature has most significant effect on the development of blowflies than the photoperiod (Sharma et al.). In legal investigations the forensic entomology involves for the interpretation of insect evidence. It has many application (Byud and Castner, 2001) but the most important investigation is involved human corpse. The insect those recovered from the fly larva and beetles give information on the condition which experienced by the body following death, sometimes it could be neglect. When the first generation of offspring from the flies to located on the corpse are still on or around it figure can used to calculate the age of largest and oldest larval on the body. Their greatest age can indicate the time when flies first laid their eggs (Donovan et al.). The standard technique can be used to calculate the development rate of insect over a time with temperature is called accumulated degree hours (ADH) or a accumulated degree of days (ADD) in which temperature above the lower development threshold (LDT) multiplied by time.

The LDT is temperature value below which insect development stop. It could be species specific and can vary between life stages. The report of study on the series of laboratory experiments that explore the effect of constant temperature on the development commonly blowfly species Calliphora vicina with the estimation of particularly ADD. Blowfly species are attracted by dead bodies of humans and animals (Greenberg and (kunichet al. 2002).

Role of environmental factor in blowfly development

Environmental factors mainly temperature, pH, humidity helped in the development of environment factor. If the temperature is high then the blowfly growth is fast, and if the temperature rate is low then the blowfly development is slow. The size of the larva can be determined by its length, which increases with its age as an outcome of temperature and time. able to define an optimal pH and, hence, a certain age limit for the eldest larvae. Markers for 15 distinct stages of growth in C. vicina pupae have been found; these stages correlate to each day that the pupae develop at 17 °C (Zehner 2021). For influencing the rate of insect development and behaviour of adult is temperature because they are poikilothermic i.e. the body internal temperature fluctuates with the ambient temperature. Temperature is not only a knowledge for accurate estimation of PMI but also important in estimating the interval of pre- appearance in an insect succession pattern (Ines et al. 2017). Temperature can affect the activity of insect which are able to fly. Natural population are mainly sample by trap and some method of analysis to attempt to difference between change in population and behavior change and relate to difference between change in population and behaviour, the activity of temperature by analysis (Taylor L R (1963). Different biogeochemical factors which are the influence of sunlight and shaded habitat and presence of toxic substance. Which can show the starting oviposition as well the blowflies development. Studies on the development and oviposition of necrophagus insect during the month of less rain and during rain of a year mainly in tropical countries such as Malaysia (Mohatet al. 2009). At multiple temperatures, the adult morphology and developmental rate of this type of blowfly were examined. As a visually adjustable distinctive, wing shape may offer information about the weather habitat that insects were placed in all over growth (Gilchrist and Huey, 2004, Gilchrist et al., 2004). Therefore, wing geometry is a viable method to figure out the temperature. However, most of the studies carried out so for the influence factors (mainly temperature) on the rate of development and the determination of less threshold temperature for the species of fly (Barnes 2017).

Development of blowfly under certain factors

Many environmental factors affect the development of blowfly which mainly have temperature, humidity, ph. If the rate of temperature rise the development of blowfly become faster and if rate of temperature is low then the growth rate

become slow. Humidity also have effect on the growth rate of blowfly if the humidity rise then the decomposition process faster and if the humidity level is low the process of decomposition is also slow.

Humidity

Humidity can also affect the growth of blowfly. In criminal cases the forensic entomology is use to determine the time period between the insect colonization and the body discovery this can be done by comparing the constrained temperature calliphorid fly development the remains of human. The post mortem interval can be estimate using the data of insect development and degree of analysis. There are many areas for the concerns of designing experiments, measurement of temperature photoperiod and relative humidity. Recently it was examined that there are problems in experiment desig in that is variability in source and failure to calculate the degree days (Nabity et al. 2007)

Temperature

Temperature played an important role in the development of blowfly. Life cycle of blowfly can be majorly affected by the blowfly (Slone et al. 2004). Temperature is used mainly to calculate the developmental rate and PMI at the current relevant temperature and also looking for the temperature of the location, the closest weather station the temperature should be recorded. The significant difference can occur between the temperature and at which the insect should developed that this situation can causing errors to calculate the post mortem interval (Greenberg 1991).

Materials and methods:

In this research work the instrument used for performing the experiments are thermometer for measurement of body temperature of carcass, pH meter is used for the measurement of soil pH hygrometer is used for measuring the humidity and amount of water vapours present in air.

We conducted our study in Mullanpur, Garibdass, Punjab, India. At this location, we set up our experimental arrangement, which included placing the carcass along with the required instruments. As part of our regular schedule, we made daily trips to the location and carefully documented several measures. These included the ambient temperature, the temperature of the corpse, the pH levels of the soil and carcass, and the degree of humidity. By continuously monitoring these characteristics for a duration of one month, we effectively collected primary data that is crucial for our study goals. Animal Model: The carcass we used for our work was a calf and we studied all the decomposition stages of that carcass. The age of animal model is 2.5 -3 years

Monitoring Parameters: Several parameters were monitored during decomposition experiments to assess the progress and dynamics of the process. These included:

•Temperature: Ambient air and substrate temperatures were measured regularly using digital thermometers or data loggers placed within the experimental units. Temperature fluctuations were recorded to evaluate their influence on blow fly activity and decomposition rates.
•Humidity: Relative humidity levels were monitored using hygrometers placed within the experimental units. Humidity data provided insights into microclimatic conditions affecting decomposition processes and blow fly behaviour,
•pH: The pupation process of blow flies is significantly influenced by the pH of the soil. Pupation usually takes place in soil that is slightly acidic, ideally in the pH range of 6-7. The pupae's ability to develop and survive can be strongly impacted by the pH of the soil. It is normal practice to use a pH meter to assess the soil pH precisely. Precise readings from this equipment guarantee that the environment is conducive to pupation. Directly beneath the cadaver, where blow fly larvae are most likely to pupate, the pH of the soil is determined. Because organic acids are released throughout the carcass's decomposition process, the pH of the soil might change, frequently becoming more acidic.

Result

Date	Temperature	Humidity	Ph
17-03-2024	30°C	36%	7
18-03-2024	31°C	37%	8
19-03-2024	31°C	39%	6.6
20-03-2024	32°C	36%	7
21-03-2024	27°C	40%	7
22-03-2024	31°C	47%	6
23-03-2-24	32°C	38%	7
24-03-2024	29°C	34%	6
25-03-2024	31°C	39%	7
26-03-2024	32°C	35%	7.5
27-03-2024	34°C	36%	7
28-03-2024	35°C	40%	6.5
29-03-2024	35°C	50%	6
30-03-2024	34°C	42%	7
31-03-2024	34°C	44%	6
01-04-2024	31°C	38%	7
02-04-2024	31°C	38%	6.5
03-04-2024	35°C	32%	7
04-04-2024	36°C	40.5%	6
05-04-2024	36°C	33.2%	6.5
06-04-2024	35°C	30%	7
07-04-2024	35°C	29%	8
08-04-2024	37°C	28%	6

09-042024	37°C	26%	7
10-04-2024	38°C	27%	6.5
11-04-2024	37°C	29%	7
12-04-2024	38°C	27%	7d
13-04-2024	34°C	34%	6.5
14-04-2024	30°C	50%	8
15-04-2024	34°C	52%	6
16-04-2024	35°C	44%	7
17-04-2024	32°C	29%	7

In this experiment we collect a data of month from 17-march -2024 to 17-april-2024. In this experiment we come to know that how environmental factors such as temperature, humidity, pH help in decomposition process. for this experiment we visit a site Mullanpur Garibdass Punjab for one month take reading on daily basis of temperature, humidity, pH and see how much time should a body took to decompose if the rate of temperature is high then the body will decompose fully in 4-5 days the larvae of blow fly larvae should be seen in bloated stage.

Discussion

This study can provide us the basic developmental data of chrysomyamegacephala. The environmental factors play a crucial role in the development and behavior of blowflies, especially from a forensic perspective. Factor such as temperature, humidity, pH helps in blow fly development, influencing their colonization patterns, growth rates and life cycle. We can collect 30 days data from 17-march-2024 to 17- April -2024 (location – Mullanpur Garibdass Punjab). This study has been conducted under natural environmental conditions at the actual site of occurrence. The maximum temperature was recorded 35°C with a minimum of 29°C and the humidity range was maximum 59% to a maximum of 20%. The most influential factors affecting the development of blow flies is temperature. Different species could have different temperature requirements for development. Higher temperatures generally accelerate development, while lower temperature slow it down. Forensic entomologist used total number hours (ADD) or total numbers of days (ADD) modes to estimate the age of blow fly larvae found on a body, based on the environmental temperature. The species. C. megacephalahave the highest abundance in summer mainly in April and declined their abundance in rainy and winter season. When the temperature become high the development and the growth rate of blow fly was increases and more the blow fly development so fast will be the body decomposed. Environmental temperature and the body temperature was not same because in the dead body of the organism certain enzymatic activities started due to which there is variation in the environmental temperature and the body temperature of the carcass. The growth and development of all organisms is

temperature dependent, but for organisms with constant body temperature. All growth depends on temperature because the biochemical reactions that are the ultimate basis for growth are themselves temperature dependent. Temperature could directly influence the development rate of blow fly. Higher temperature can lead to fast the growth rate and maturation of blow fly eggs, larvae and pupae. And the lower temperature should prolong each stage the life cycle. Important role can be played by the temperature in the egg hatching of blow fly. If the temperature can be warmer than the hatching of eggs become faster and, while the cooler temperature can slow it down. In forensic investigations this factor can help in calculating the age of the blow fly larvae which could be found in the corpse. For the growth of the blow fly larvae the warmer temperature should be required, if the temperature can be warmer it can speed up the larval growth, enable the larvae to reach to the pupa stage fast, whereas cooler temperature slow down the larval growth and more time should be taken for larvae to mature. Temperature can also affect the pupa stage of the blow fly, warmer temperature makes pupal period short while the cooler temperature took longer time to reach to adult stage, during warmer temperature the blow flies reproduce faster and are more active, while in winter or rainy season these flies' activity slow down.

Humidity plays an important role in blow fly development because blowfly life cycle can be affected, also rate of decomposition. Humidity can impact the availability of moisture needed by the larvae of blow fly to grow fast and also for feeding. Blow flies lay their eggs on decomposing organic matter, such as carcasses or the decaying organic matter. Higher level of humidity can help in hatching of blow fly eggs by providing them necessary moisture for egg membrane to remain intact and for embryonic development to occur. Once the egg can hatch and larvae start feed on the decomposing matter. Humidity is important for the larval development and growth, higher levels of humidity can dry out the larvae, they should be hydrated and active metabolically. Blow fly larvae feed on the consuming a large amount of decomposing tissue for their growth. Optimal humidity level contributes the availability of the moisture in the substrate decomposing, which can make easier for the larvae to feed and digest organic matter easily. After completing the larval stage, the larvae of blow fly can pupate in drier environment which can be away from the decomposing substrate. Humidity can play a role during pupation. Moderate humidity is necessary to prevent the pupae and help the formation of pupal case.

pH played role in blow fly development. The value pH in this study should be take place from 6 to 8. Blow flies can lay their eggs on the substrate with some pH levels. Blow flies mainly choose the substrate which have acidic pH. Microbial activities can be influenced the pH present on the decomposing substrate. The larvae of the blow fly cannot feed only on the decomposing matter but also on the microbes present there. The substrate pH can affect the abundance and type of microorganism located there, which could impact the development of the larvae. Extreme pH levels can be toxic for the development of blow fly larvae. Very acidic

or alkaline conditions can stop the development of larva and cause mortality. Maintaining suitable pH range is essential for the development of blow flies. In protein degradation in the decomposing tissue can influence by pH. Proteins are the primary food source for the blow fly. So, the pH of the substrate can affect the availability and the breakdown of the proteins and help in larval development and growth.

Conclusion

From this experiment it can be concluded that the environmental factors help in the blow fly development. In this experiment we collect 30 days data to temperature, humidity, pH from this data we can easily see the development of blowfly. The temperature range in blowflies is 24°c-30°c. Relative humidity and temperature both have impact on blowfly development are interdependent and in experimental trails it cannot easily to separate their effect on the activity of fly. High relative humidity can affect the development of adult blowflies slowing their activity and reducing lifespan. Rainfall is a humidity measure which can create problem that flies access to corpse. The blow fly larvae development can be seen on the carcass we can identified at the location that carcass we identified from fresh stage to skeleton stage. While doing this experiment some difficulties can also be faced regarding the weather or the area. On that carcass in bloated stage the larvae can be seen which can be first instar larvae, second instar larvae, and third instar larvae and pupae can also be find. In this way the high rate of temperature and humidity and fast the process of decomposition. In these months there is no much variation in temperature so the development can be easily identified.

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